

Antibiotic Resistance Patient Safety Atlas

Data Methodology

Explanation of Methodology Used

The Antibiotic Resistance Patient Safety Atlas (AR Atlas) includes data from healthcare-associated infection (HAIs) reported to CDC's National Healthcare Safety Network (NHSN) from healthcare facilities in the United States. More information about NHSN, including details on the surveillance methodology, can be found at <http://www.cdc.gov/nhsn/about-nhsn/index.html>.



Events Represented in the AR Atlas

The AR Atlas includes data elements from the following three HAI types that were reported to the Device- and Procedure-associated Modules of the Patient Safety Component of NHSN: central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTIs), and surgical site infections (SSIs) following inpatient procedures. CLABSI and CAUTI captured in the AR Atlas occurred between 2011-2014 in any type of inpatient location in the facility. All types of SSIs (superficial, deep, and organ/space) that occurred following any NHSN inpatient procedure performed between 2011-2014 with a primary closure technique are included. HAIs captured in the AR Atlas were included in a facility's NHSN monthly reporting plan and were submitted to NHSN with all required data elements as of December 16, 2015. Data elements related to antibiotic resistance testing were extracted from each event, and aggregated across different strata based on type of infection, state, year, and patient's age.

Healthcare Facilities Included and Relationship to CMS Quality Reporting Programs

All facilities that reported at least one eligible HAI to the Patient Safety Component of NHSN are included in the AR Atlas. This covers acute care hospitals, long-term acute care hospitals (LTACHs), inpatient rehabilitation facilities (IRFs), critical access hospitals, oncology hospitals, pediatric hospitals, military and VA hospitals, surgical and orthopedic hospitals, and psychiatric hospitals. Patient settings related to outpatient care or nursing home/skilled nursing are not included in the AR Atlas. The extent of reporting from the different facility types varies and is driven largely by the Quality Reporting Programs managed by the Centers for Medicare & Medicaid Services (CMS). The Hospital Inpatient Quality Reporting Program for acute care hospitals mandated the reporting of CLABSI among critical care patients starting in January 2011, and the reporting of CAUTIs in critical care patients and SSIs following abdominal hysterectomies and colon surgeries in January 2012. CMS mandated CLABSI and CAUTI reporting from LTACHs and CAUTI reporting from IRFs beginning in October 2012. While both state mandates and federal Quality Reporting Programs influence the types of data submitted to NHSN, data included in the AR Atlas are not limited to the specifications of such reporting programs, and include facilities that are not participating in these programs.

Pathogen and Antimicrobial Susceptibility Data

Pathogen and antimicrobial susceptibility data reported to NHSN are provided by the facility's designated clinical microbiology laboratory. Laboratories are expected to use Clinical and Laboratory Standards Institute standards for antimicrobial susceptibility testing. Susceptibility results for each pathogen were reported using the category interpretations "susceptible" (S), "intermediate" (I), "resistant" (R), or "not tested". Up to three unique pathogens can be reported per CLABSI or CAUTI event; however, note that SSIs can be reported to NHSN without a pathogen. Any SSI without an associated pathogen is not included in the AR Atlas.

For all pathogens included in the AR Atlas, there was a select group of antimicrobials for which susceptibility test results must be reported to NHSN; these pathogen-antimicrobial combinations were then used to define the selected phenotypes. Because laboratories may test different antimicrobial agents within a class, for some phenotypes resistance was defined using data from at least one of several agents within the same antimicrobial class. The AR Atlas includes 31 antimicrobial resistant phenotypes of epidemiologic importance. Please refer to the “Pathogen Definitions List” for definitions of each phenotype.

Summary Measure of Antibiotic Resistance

For each HAI type, time period, age group, and state, a pooled mean percent resistance (i.e., %R: the pooled proportion of pathogens that tested resistant, or for some phenotypes non-susceptible, to antimicrobial agents) was calculated for each pathogen-antimicrobial agent combination by pooling data from all NHSN hospitals for the specified time period. This proportion is calculated as the sum of pathogens that tested resistant (“number resistant”), divided by the sum of pathogens tested for susceptibility (“number tested”), multiplied by 100. The pooled mean percent resistance was not calculated for any pathogen-antimicrobial agent combination for which less than 20 isolates were tested. The national, regional, and state-level data included in the AR Atlas are displayed with 95% confidence intervals around the percent resistance, which were calculated using a mid-P exact test and are an indication of precision.

Variables Currently Available for Stratification of Pooled Mean Percent Resistance (%R)

1. State: Includes 50 U.S. states, District of Columbia, and Puerto Rico. Small islands and territories (e.g., Virgin Islands, Guam) are not shown at the state-level, but are included in the national resistance measure.
2. Region: Defined by the nine U.S. Census Divisions (http://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf). Small islands and territories including Puerto Rico are not included in the regional display, but are included in the national resistance measure.
3. Age: Four categories; < 1 year, 1-18, 19-64, 65+
4. Year: Pooled mean percent resistance is calculated for each year (2011, 2012, 2013, 2014), and as a combined value for 2011-2014. The percent resistance is calculated for the most recent four years of data; this allows aggregation of multiple years of data and can be especially helpful for rare pathogens that do not meet the denominator threshold for calculating percent resistance in a single year. This also provides a way to review antimicrobial resistance data regardless of any non-significant or random variation that occurs from year to year.
5. Event Type: CLABSI, CAUTI, SSI

Limitations of the Data

Raw and unadjusted antimicrobial resistance data are presented in the AR Atlas. The AR Atlas does not include statistical trend analyses or other statistical comparative tests, and this should be considered when interpreting data presented on this site. Due to changes in NHSN definitions and surveillance protocols, caution should be used when comparing resistance data between years. The AR Atlas should not be used to make definitive conclusions about the changes in antimicrobial resistance over time, or conclusions surrounding the comparison of a state’s resistance to the national resistance.

Differences may exist in the testing and reporting methods between individual laboratories that could cause inconsistencies in the reported data. NHSN captures only the interpretation (S, I, or R) and not the measured minimum inhibitory concentration, and the interpretations of breakpoints may vary slightly between laboratories depending on the version of CLSI standards in use. When reviewing state-level data, it is important to note that the amount and types of data reported may vary by state due to different state legislation and reporting mandates. Furthermore, the HAI data reported from facilities may not be validated, or validated to the same

extent, from every state. States with more intensive data validation programs may have more HAI events reported to NHSN. While the data shown in the AR Atlas represent HAIs reported from almost all acute care hospitals, LTACHs, and IRFs in the U.S., they do not include all types of HAIs and are not representative of the entire U.S. population.

It should be noted that the HAI events reported to NHSN represent a subset of all HAIs occurring in various patient settings in the U.S.: CLABSI, CAUTI, and SSIs following Surgical Care Improvement Project Procedures reflect approximately 25% of the 721,800 HAIs that have been estimated to occur nationally each year during hospitalization in acute care hospitals (Table 4, N Engl J Med 2014; 370:1198-1208).

For more information about the AR Atlas, visit:

<http://www.cdc.gov/hai/surveillance>